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THE IMPACT OF TAX AND INFRASTRUCTURE COMPETITION ON THE PROFITABILITY OF LOCAL FIRMS

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The impact of tax and infrastructure competition on the profitability of local firms*

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Abstract

International capital mobility intensifies tax competition between jurisdictions. However, many firms only operate domestically and are internationally immobile. This paper aims to analyze the effect of tax competition on the profitability of local (immobile) firms, especially when tax and non-tax instruments, including infrastructure provision, are involved. We show that tax competition decreases investment and profit of local firms when internationally mobile firms do not benefit sufficiently from local infrastructure.

JEL classification: F21, F23, H25, H26.

Keywords: Local firms, multinational firms, tax competition, infrastructure competition, tax harmonization.

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Résumé non technique

Ce cahier vise à contribuer à la littérature sur la concurrence fiscale en développant un modèle destiné à étudier l'impact sur les entreprises locales quand cette concurrence s'étend aux investissements en infrastructure publique. Nous argumentons ainsi que les politiques fiscales nationales, par le biais des mouvements internationaux de capitaux qu'elles engendrent, ont une influence sur l'activité locale.

Une intégration économique accrue qui s'observe au cours des dernières décennies ainsi que l'émergence de la digitalisation, ont fait que les politiques fiscales nationales sont de plus en plus mises en relation avec des considérations internationales. Cependant, toutes les entreprises (ou les capitaux) n'ont pas le même dégrée de mobilité. Les entreprises multinationales doivent être distinguées des entreprises locales qui opèrent uniquement au niveau domestique et sont donc immobiles sur le plan international. Des études récentes utilisant la base de données AMNE de l'OCDE montrent que la part des entreprises locales est particulièrement importante et représente environ 70 pour cent de la production mondiale et du PIB mondial. Néanmoins, la littérature sur la concurrence fiscale se concentre presque exclusivement sur le rôle des entreprises mobiles.

Ce travail contribue au moins de deux manières à la littérature. En premier lieu, il considère que les pays sont en mesure d'attirer des entreprises et des capitaux étrangers en investissant dans des infrastructures publiques. Ces investissements peuvent être très variés. Il peut s'agir d'investissements publics dans les réseaux de télécommunications et de transport ou dans la recherche et développement, mais aussi de la mise en œuvre de règlementation attractive et d'institutions favorisant une bonne gouvernance. Des études empiriques récentes montrent que ces types d'infrastructure sont un déterminant important des choix de localisation des entreprises internationales. Ensuite, ce cahier analyse l'impact de la concurrence fiscale et d'infrastructures sur le profit et l'investissement des entreprises locales.

Le principal constat de notre réflexion est que la qualité des infrastructures joue un rôle primordial dans l'impact sur les entreprises locales de la concurrence pour de capitaux étrangers. Nous montrons notamment que la concurrence fiscale diminue les investissements et le profit des entreprises locales lorsque les infrastructures publiques ne correspondent pas suffisamment aux besoins des entreprises étrangères. Un moyen de réduire ces effets négatifs peut consister à mieux cibler les besoins des entreprises mobiles lors

de la conception d'infrastructures publiques.

1 Introduction

Economic integration favors international mobility of business activities, making firms' international location decisions and investment more responsive to differences in national tax rates. Therefore, increased capital mobility intensifies tax competition among jurisdictions. The tax competition literature has focused on a possible race to the bottom in corporate tax leading to a decline in tax revenues and in the provision of public goods.[1]

However, firms and capital investment are not all internationally mobile to the same extent. Many firms operate domestically within their home country.[2] One reason for this decision is to benefit from an environment with familiar local rules and practices.[3] Transferring activities abroad requires substantial information, raising transaction costs. In this context, many authors argue that capital is largely immobile internationally because of information asymmetry between home and foreign locations (e.g., Gordon and Bovenberg, 1996; Ahearne et al., 2004). According to Cadestin et al. (2019), 67 percent of global output and 72 percent of world GDP is produced by domestic firms.

The theoretical literature on tax competition has mainly focused on different degrees of capital mobility when the mobile tax base enjoys preferential treatment or firms are otherwise favored (see for example, Janeba and Peters, 1999; Keen, 2001; Marceau et al., 2010; Mongrain and Wilson, 2018). This strand of literature focused on comparing the impact of tax competition on tax revenues with and without tax discrimination.

However, to the best of our knowledge, the literature has not yet addressed the possible effect of tax competition on the profitability of local (non-mobile) firms, especially when both tax and non-tax instruments are involved. The aim of this paper is to fill this gap by considering that competing jurisdictions set tax and infrastructure investment independently and strategically to attract internationally mobile capital. This was clearly demonstrated by recent empirical research (Hauptmeier et al., 2012), and has also been highlighted theoretically by various authors. For example, Hindriks et al. (2008) consider a federation with two heterogeneous regions competing in

[1] Tax competition was formally modeled by Zodrow and Mieszkowski (1986) and Wilson (1986). Numerous extensions followed (see comprehensive surveys in Wilson, 1999; Wilson and Wildasin, 2004; Boadway and Tremblay, 2011).

[2] This does not exclude that they can export their products.

[3] For example, accounting rules and regulations and laws defining governance practices.

taxes and public investment under fiscal equalization. Zissimos and Wooders (2008) study how firms differ in their requirements for public goods, leading to differentiation in public good provision across countries. Pieretti and Zanaj (2011) introduce public infrastructure in tax competition with two unequally sized countries.

The model developed below considers two jurisdictions populated with the same number of capital owners, who decide to set up firms in their country of residence. These local firms are considered immobile. Moreover, there are international capital owners (or multinational companies) who decide to set up affiliates in the two jurisdictions. These firms are considered mobile. Accordingly, the two jurisdictions compete with taxes and infrastructure to attract mobile firms from abroad. Moreover, we assume that public infrastructure may benefit mobile and immobile firms differently, as supported empirically (Bellak et al., 2009). This model serves to explore how tax and infrastructure competition affects capital investment and the profitability of local firms.

Our main results are the following. An increase in mobile capital relative to immobile capital can decrease investment and profits of local firms. This negative impact occurs when the internationally mobile firms do not benefit sufficiently from infrastructure provided by the competing jurisdictions. In this case, the increase in competition leads to a decline in tax rates that does not benefit local firms enough to compensate for the decrease in infrastructure provision. Interestingly, this adverse effect can still occur when the jurisdictions agree on harmonized tax rates but still compete in infrastructure provision. It follows that tax harmonization is not always beneficial to local firms.

An important message of this paper is that the quality of public infrastructure investment largely determines how competition for foreign capital affects local firms. Indeed, tax competition to attract mobile capital can reduce the profitability of local businesses if policymakers design public infrastructure in a way that does not sufficiently match the needs of internationally mobile firms.

Finally, we analyze tax and infrastructure competition when tax discrimination can be used to attract multinational corporations. Preferential tax treatment for firms without substantial economic activity in the country is considered a harmful tax practice by the OECD (BEPS minimum standard) and by the EU Code of Conduct on Business Taxation. Within the EU, articles 107 and 108 of the Treaty prohibit state aid, including tax discrimination, in so far as it distorts competition and it is incompatible with the internal market. In this context, our analysis of tax discrimination can provide some perspective on the current situation regarding Brexit. By leaving the EU, the UK hopes to be free of restrictions on state aid and could therefore implement preferential tax treatment with an impact on EU firms.[4]

We find that with tax discrimination, an increase in mobile capital relative to immobile capital always has a positive effect on local investment and profits. However, tax discrimination decreases the profitability of local firms because it raises tax rates for local firms, decreasing their profit, and this is not compensated by a change in infrastructure provision.

The paper is structured as follows. The next section develops a model of tax and infrastructure competition and studies how mobile capital affects the profitability of local firms. Section 3 assumes that countries compete in infrastructure provision but harmonize corporate tax rates. Finally, Section 4 considers preferential tax regimes and the last section concludes.

2 A model of tax and infrastructure competition with local firms

Consider a world economy with two countries indexed by $i = 1, 2$. Each country i has a given number of N_i local capitalists each of them owning one firm. Capital invested in one local firm in country i is k_{ni}. As thse firms are local, this capital is considered immobile. Moreover, there are M internationally mobile capital owners (or multinational companies) who can set up a firm in country 1 and/or 2. Let k_m be the total capital invested by each mobile capital owner or MNC. It follows that an investment in country i is $k_{mi} = \theta_i k_m$, where θ_i ($\theta_i \in [0, 1]$ with $\sum_i \theta_i = 1$) is the share of mobile capital invested in location i. The firms set up by mobile capital owners are referred to as mobile firms. Thus, as in Marceau et al. (2009), we model the different degrees of capital mobility as mobile and immobile firms.

As in Bucovetsky and Smart (2006) and Eggert and Itaya (2014), we assume that labor input is fixed for each firm and we normalize it to 1 and the corresponding wage rate w to zero. It follows that the production function is concave in capital. The production factors are capital and public infrastructure. The production function of a mobile (eq. 1a) and local (eq.

[4]For additional discussion, see Fuest and Sultan, 2019.

1b) firm in country $i = 1, 2$ are

$$f(k_{mi}) = (1 + cg_i)\, k_{mi} - \frac{k_{mi}^2}{2}, \tag{1a}$$

$$f(k_{ni}) = (1 + g_i)\, k_{ni} - \frac{k_{ni}^2}{2}, \tag{1b}$$

where g_i is the infrastructure provision in country i and $c \in R^+$ is a parameter that accounts for the extent to which mobile firms benefit from public infrastructure. If $c = 1$, infrastructure provision benefits local firms internationally mobile firms equally. However, c can be different from 1. When $c < 1$, infrastructure investment benefit local firms more than mobile firms. Conversely, when $c > 1$, infrastructure benefit mobile firms more than local firms. This can be the case for very small open economies or some developing countries where the share of local immobile firms is very small and perhaps negligible. When the number of local firms is significant, it is hardly realistic to assume that public decision-makers will favor MNCs when designing infrastructure provision. Given that local firms are the focus of this paper, we shall subsequently assume $c \in [0, 1]$.

Public infrastructure may benefit immobile and mobile firms differently ($c \neq 1$). For example, Bellak et al. (2009) focus on the role of infrastructure and taxes as determinants of FDI in Central and Eastern European countries (CEECs). They show that infrastructure is a relevant location factor for foreign investment in CEECs. However, they also observe that different types of infrastructure are, in this specific case, not of equal importance in attracting FDIs. In this context, information and communication infrastructure is more important than transport infrastructure and electricity generation capacity. In our model, this is captured by a c lower than 1. More generally, the difference between 1 and c can be interpreted as an indicator of the mismatch between the preferences for infrastructure of local and mobile firms.

Infrastructure has the nature of a local public good, which augments the production of all firms located in the country. We suppose that the cost of investing increases more than proportionally with the amount of invested capital. For an MNC, the cost of investing in both jurisdictions is $C(k_m) = \frac{1}{2}k_m^2$ and for local firms it is $C(k_{ni}) = \frac{1}{2}k_{ni}^2$. The convexity of this cost function accounts for the fact that it is increasingly difficult to afford additional capital.

Moreover, we assume that each country levies a proportional tax on capital. The tax rate in country i is t_i.

The total profit (net of taxes) of a representative MNC is

$$\Pi_m(k_m) = \sum_{i=1}^{2} \left[f(\theta_i k_m) - \theta_i k_m t_i \right] - \frac{k_m^2}{2}. \tag{2}$$

Each MNC maximizes its profit by deciding on the share of capital invested in each location and on the total amount of capital k_m. Maximizing 2 relative to θ_i $(i = 1, 2)$ yields

$$\theta_i = \frac{1}{2} \left[1 + \frac{c(g_i - g_{-i}) - (t_i - t_{-i})}{k_m} \right]. \tag{3}$$

Introducing 3 into 2 and then maximizing the profit (net of taxes) of the representative MNC relative to k_m yields

$$k_m = \frac{1}{3} \left(2 + c(g_i + g_{-i}) - (t_i + t_{-i}) \right). \tag{4}$$

and

$$k_{mi} = \theta_i k_m.$$

Each local firm in country $i = 1, 2$ maximizes the following profit equation relative to k_{ni}

$$\Pi_{ni}(k_{ni}) = f(k_{ni}) - k_{ni} t_i - \frac{k_{ni}^2}{2}. \tag{5}$$

The first order condition is

$$k_{ni} = \frac{1}{2}(1 + g_i - t_i). \tag{6}$$

The equilibrium profit becomes

$$\Pi_{ni} = k_{ni}^2.$$

2.1 Tax and infrastructure competition

In the following, we assume that countries compete with taxes and infrastructure to attract mobile firms. As mentioned above, this is supported by empirical studies. The cost of providing attractive infrastructure increases at an increasing rate. This can be explained by the limited availability of human resources for the provision of public goods and services. Another reason can be the need for political consensus when deciding additional infrastructure expenditures.

For simplicity, we assume that this cost is given by a quadratic function

$$C(g_i) = \gamma \frac{g_i^2}{2},$$

where $\gamma > 0$ measures the efficiency of country 1 and 2 in providing attractive infrastructures. The coefficient γ accounts for the capacity of a jurisdiction to cope with key stages of public infrastructure investment, which consist of planning, allocation and implementation. The higher the value of γ the lower the efficiency in providing g_i.

A growing body of literature emphasizes the importance of legal, institutional, and procedural arrangements for public investment management. It follows that the efficiency in infrastructure provision may differ across countries. Assessments made by the IMF (2015) highlight average inefficiencies in public investment processes of around 30 percent, which are not particular to developing countries. Moreover, Kenny (2009) reports differences in the building cost of a kilometer of similar roads that vary by five to ten times across different countries. In the above cost function, this aspect is captured by considering different values of the coefficient γ for a given value of g_i.

Each country i chooses its level of public infrastructure g_i and corporate tax rate t_i to maximize its tax revenue[5] net of the cost of providing infrastructure

$$B_i = (M\theta_i k_m + N_i k_{ni})\, t_i - \gamma \frac{g_i^2}{2}\ , \tag{7}$$

where M is the number of internationally mobile firms, and N_i the number of immobile firms in country i. In the following, we normalize $N_i = 1\ \forall i$, so that M represents the relative share of mobile firms.

In the literature on tax and infrastructure competition, it is not uncommon to assume that competing governments maximize their tax revenue net of infrastructure costs (see for example, Zissimos and Wooders, 2008 and Pieretti and Zanaj, 2011).

Let's now plug 3, 4 and 6 into 7. Then we maximize the objective function of country i relative to t_i and g_i.

[5]This assumption is consistent with a welfarist view in which the marginal valuation of public good, financed by tax revenue, is very high (see Kanbur and Keen, 1993).

The first order conditions, which are also sufficient, yield

$$t_i = \frac{2M\,(1 + c(2g_i - g_{-i}) + t_{-i}) + 3(1 + g_i)}{2(3 + 4M)} \ ,$$
$$g_i = \frac{3 + 4cM}{6\gamma} t_i \ .$$

It follows that the best responses of country i are

$$\begin{aligned} t_i &= \frac{6\gamma}{\Omega}\,(2Mt_{-i} - 2Mcg_{-i} + 2M + 3) \qquad (8) \\ g_i &= \frac{(3 + 4cM)}{\Omega}\,(2Mt_{-i} - 2Mcg_{-i} + 2M + 3) \end{aligned}$$

with $\Omega = 12\gamma(3 + 4M) - (3 + 4cM)^2 > 0$ if $\gamma > \gamma_1 = \frac{(3+4cM)^2}{12(3+4M)}$.

Given that the competing jurisdictions are identical, we obtain a symmetric equilibrium. Thus, we can write $t_i = t_{-i} = t^*$ and $g_i = g_{-i} = g^*$. It follows that

$$\begin{aligned} t^* &= \frac{6\gamma(3 + 2M)}{D} \ , \qquad (9) \\ g^* &= \frac{(3 + 4cM)(3 + 2M)}{D} = t^* \frac{3 + 4cM}{6\gamma} \ . \end{aligned}$$

where $D = 36\gamma(1+M) - (3+2cM)(3+4cM) > 0$, if $\gamma > \gamma_2 = \frac{(2Mc+3)(4Mc+3)}{36(M+1)}$. Moreover, to guarantee that $t^* \leq 1$, we impose that $\gamma \geq \widehat{\gamma} = \frac{(3+2cM)(3+4cM)}{6(3+4M)}$. It is convenient to demonstrate that this last condition verifies the above non-negativity conditions. In other words, we must have $\gamma > \widehat{\gamma} > \max\{\gamma_1, \gamma_2\}$.

The equilibrium share of mobile capital invested in location i is $\theta_i^* = \frac{1}{2}$. It follows that the equilibrium amount of capital invested by a representative MNC in each location is $k_{mi}^* = \theta_i^* k_m^* = \frac{k_m^*}{2}$ with

$$k_m^* = \frac{2}{3}\left(1 + t^* \frac{3(c - 2\gamma) + 4c^2 M}{6\gamma}\right).$$

The equilibrium level of capital invested by each local firm is

$$k_n^* = \frac{1}{2} + t^* \left(\frac{3(1 - 2\gamma) + 4cM}{12\gamma}\right).$$

The equilibrium profit of each local firm becomes

$$\Pi_n^*(k_n) = \left(1 + (3+2M)\left(\frac{3(1-2\gamma)+4cM}{D}\right)\right)^2 . \tag{10}$$

Finally, we can calculate the equilibrium budget B^* of the competing jurisdictions. After plugging all the equilibrium values into equation 7, we get

$$B^* = \frac{1}{2}\gamma \frac{(2M+3)^2\left(12\gamma\,(4M+3) - (4Mc+3)^2\right)}{\left((4Mc+3)\,(2Mc+3) - 36\gamma\,(M+1)\right)^2}.$$

It follows that the equilibrium tax revenues are sufficient to fund the equilibrium infrastructure provision. Indeed, it is easy to check that $B^* > 0$ given that $\gamma > \widehat{\gamma} > \frac{(4Mc+3)^2}{12(4M+3)}$.

2.2 Effects of increasing mobile capital

In this subsection, we study the effect of an increase in the supply of internationally mobile capital (M increases) relative to the supply of immobile capital. Accordingly, the two countries will compete for a larger amount of international capital and thus for a larger tax base. Given that taxation and infrastructure provision are, to a certain extent, tailored to attract foreign investment, we address the following questions. How does an increase in the supply of mobile capital affect taxation and infrastructure provision? How do these changes affect investment and the profitability of immobile firms?

Impact on equilibrium tax rates and infrastructure provision

The sensitivity of equilibrium tax rates and infrastructure provision to changes in M is determined by the following derivatives

$$\frac{\partial t^*}{\partial M} = 112\gamma \frac{8Mc^2\,(M+3) + 9(3c-1) - 18\gamma}{(9+18cM+8c^2M^2 - 36(1+M)\gamma)^2} ,$$

$$\frac{\partial g^*}{\partial M} = \frac{4\ c\ t^* + (3+4cM)\frac{\partial t^*}{\partial M}}{6\gamma}.$$

It is convenient to show that $\frac{\partial t^*}{\partial M} < 0 \ \ if \ \ \gamma > \gamma_t$ where $\gamma_t = \frac{8Mc^2(M+3)+9(3c-1)}{18}$ and that $\frac{\partial g^*}{\partial M} > 0 \ \ if \ \ \gamma > \gamma_g$ where $\gamma_g = \frac{-16M^2 c^3+8M(2M-3)c^2+(24M-9)c+9}{6(4c(2M(M+2)+3)-3)}$.[6]

In addition, note that $\gamma_g > \gamma_t$ when $c < \overline{c} = \frac{3\sqrt{8M(M+2)+9}-9}{8M(M+2)}$.

Accordingly, an increase in M can lead to one of the following three cases.[7]

- When $\gamma_g > \gamma > \gamma_t$, an increase in internationally mobile capital decreases both the corporate tax rate and infrastructure investment ($\frac{\partial t^*}{\partial M} < 0$ and $\frac{\partial g^*}{\partial M} < 0$).
- When $\gamma > \max\{\gamma_g, \gamma_t\}$, an increase in mobile capital increases the infrastructure provision but decreases the corporate tax rate ($\frac{\partial t^*}{\partial M} < 0$ and $\frac{\partial g^*}{\partial M} > 0$).
- When $\gamma_t > \gamma > \gamma_g$, an increase in mobile capital has a positive impact on both the corporate tax rate and infrastructure investment ($\frac{\partial t^*}{\partial M} > 0$ and $\frac{\partial g^*}{\partial M} > 0$).

Before explaining the intuition behind these results, note that the thresholds $\widehat{\gamma}, \gamma_t$ and γ_g depend on the parameter c. It can be shown that $\widehat{\gamma}$ and γ_t are increasing and γ_g is decreasing in c. Figure 1 shows how these threshold-values change with respect to c, for a given value of M. In this Figure, we can identify three different regions associated with different levels of c.

First, there is one region for relatively small values of c, where $\frac{\partial t^*}{\partial M} < 0$ and $\frac{\partial g^*}{\partial M} < 0$. Then, there is a second region for intermediate values of c where $\frac{\partial t^*}{\partial M} < 0$ and $\frac{\partial g^*}{\partial M} < 0$. Finally, we can define a third region for relatively high values of c where $\frac{\partial t^*}{\partial M} > 0$ and $\frac{\partial g^*}{\partial M} > 0$.

Therefore, the impact of an increase in M on the equilibrium depends[8] on the level of c, which measures how much multinational firms benefit from local infrastructure provision relative to local firms. To understand the intuition for the above results, consider first the case of $c = 0$. In this case, the jurisdictions only compete with taxes because infrastructure does not affect the output of mobile firms. It follows that an increase of the supply of mobile capital exacerbates tax competition, which results in lower equilibrium

[6]Note that $\gamma_g(c)$ is not defined for $c \in \left(0, \overline{\overline{c}}\right)$ with $\overline{\overline{c}} = \frac{3}{8M(M+2)+12}$. In fact, $\lim_{c \to \overline{\overline{c}}} \gamma_g(c) = +\infty$.

[7]The case in which $\gamma < \min\{\gamma_t, \gamma_g\}$ can be disregarded because $\gamma \geq \widehat{\gamma} > \max\{\gamma_t, \gamma_g\} \geq \min\{\gamma_t, \gamma_g\}$.

[8]For given values of γ.

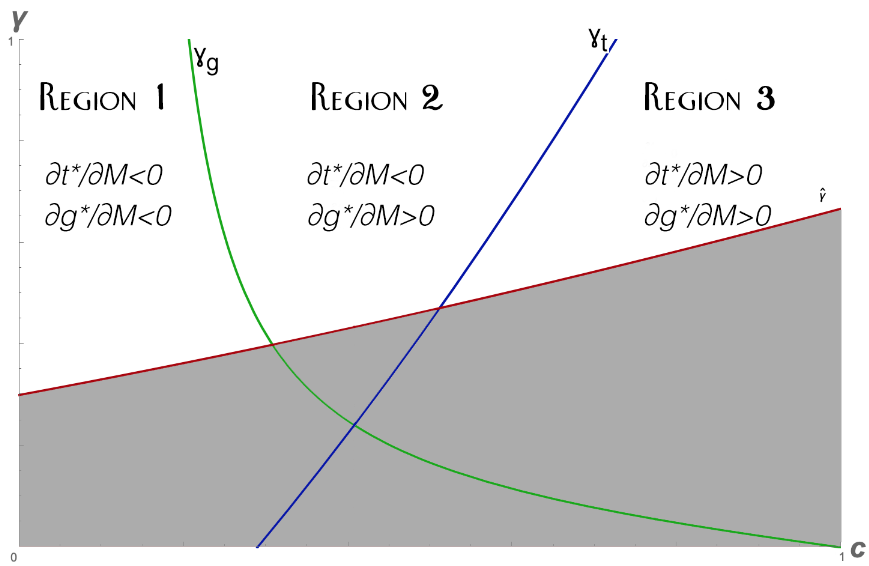

Figure 1: Effect of an increase in mobile capital on taxes and infrastructure investment

tax rates. Notice that $\frac{\partial t^*}{\partial M} < 0$. In addition, M has a negative impact on infrastructure provision ($\frac{\partial g^*}{\partial M} < 0$). To understand why, note first that the share of local capital in the total tax base shrinks when more capital flows in (increasing M). This reduces the relative importance of local firms in the governments' objective function. Consequently, infrastructure provision decreases, given that it only benefits local firms.

Now, consider positive values of parameter c. For low and moderate values of c, the impact of an increase in M on the equilibrium tax rates still remains negative. The impact on the equilibrium infrastructure provision is negative when c remains relatively low, and it only becomes positive when parameter c is high enough. This means that when foreign MNC affiliates are weakly dependent on local infrastructure provision, an increase in the international supply of mobile capital intensifies tax competition at the expense of infrastructure provision. In the intermediate range of c, host countries intensify competition for mobile capital in both taxes and infrastructure provision. Finally, when the productivity of the foreign MNC affiliates is highly dependent on infrastructure provision (when c is relatively high) an increase in M induces the host countries to focus on infrastructure competition, thus reducing the intensity of tax competition. As a result, the equilibrium tax rates increase.

The following proposition summarizes the above results.

Proposition 1 *An increase in the supply of mobile capital affects taxes and infrastructure provision differently depending on the extent to which mobile firms benefit from public infrastructure. If c is relatively low, increasing mobile capital reduces taxes and infrastructure provision. For intermediate levels of c, the equilibrium tax rate still declines but infrastructure provision increases. Finally, when c is relatively high, both the tax rate and infrastructure provision increase.*

Impact of M on local firms

Equation 10 can help us calculate the impact of an increase in the supply of internationally mobile capital (increase in M) on the equilibrium investment of the representative local firm k_n^*. Recalling that $\Pi_n^* = k_n^{*2}$, we see that the impact of an increase in M on the investment of a local firm and its profitability have the same sign.

Therefore, it is sufficient to consider the sign of the following derivative

$$\frac{\partial k_n^*}{\partial M} = \frac{16c(c^2+3\gamma-c(1+\gamma))M^2+24c(c-1+(2-c)2\gamma)M+9(1+2\gamma)(c-1+2\gamma)}{\frac{1}{6}D^2}. \tag{11}$$

First, we see that when host countries only compete on taxes, namely when $c = 0$, the impact of an increase in mobile capital on local investment and local profits depends on the efficiency of infrastructure provision. Indeed, it is easy to show that

$$\frac{\partial k_n^*}{\partial M} = \frac{2\left(2\gamma-1\right)\left(2\gamma+1\right)}{3\left(4\gamma+4M\gamma-1\right)^2}.$$

In particular, if $\gamma < \frac{1}{2}$, then $\frac{\partial k_n^*}{\partial M} < 0$. In other words, an increase in the supply of internationally mobile capital negatively affects local profit if jurisdictions are efficient enough in providing attractive infrastructure. As highlighted above, increasing mobile capital decreases the relative importance of local firms in the objective function. It follows that infrastructure provision decreases because it only benefits local firms. However, the more efficient the provision of infrastructure, the stronger the decrease in infrastructure provision. This induces a negative effect on the profit of local firms that is not compensated by the reduction of the tax rate.

Second, when $c > 0$, it is easy to demonstrate that $\frac{\partial k_n}{\partial M} \geq 0$ if $\gamma \geq \gamma_k$ and $\frac{\partial k_n}{\partial M} < 0$ otherwise.[9] In other words, when $\gamma < \gamma_k$, investment and profits of local firms decrease. It can be shown that γ_k is such that $\gamma_t < \gamma_k < \gamma_g$, where $\frac{\partial t^*}{\partial M} < 0$ and $\frac{\partial g^*}{\partial M} < 0$.[10]

The following proposition concludes.

Proposition 2 *If multinational firms do not benefit sufficiently from local infrastructure and infrastructure provision is sufficiently efficient, an increase in internationally mobile capital lowers investment and profits in local firms.*

3 Tax harmonization and infrastructure competition

In this section, we assume that the jurisdictions decide to apply a common tax rate that maximizes their joint tax revenue. However, competition continues on infrastructure provision. Therefore, the cooperative decision on a common tax rate depends on the anticipated response in infrastructure provision. First, we consider how countries determine the level of their infrastructure expenditures for any given harmonized tax rate. Then, we determine the harmonized tax rate that maximizes joint tax revenue.

Each MNC maximizes its profit by first deciding how to allocate a given amount of total capital k_m among the two locations and then choosing how much total capital k_m to invest. For a given common tax rate t^c and a given

[9] With $\gamma_k = \frac{E+8M(M+3)\,c^2-3(8M(M+2)+3)c}{36}$
where
$E = \sqrt{Ac^4 + B\,c^3 + C\,c^2 + D_E c + 324}$
with
$A = 64M^2\,(M+3)^2$
$B = -48M\left(9\,(7M+1) + 8M^2\,(M+5)\right)$
$C = 144M^2\,(4M\,(M+4)+23)+81$
$D_E = 108\,(8M-3)$

[10] More precisely, $\gamma_g - \gamma_k > 0$ for all $c \in \left(\bar{\bar{c}}, \bar{c}\right)$.

infrastructure provision g_i and g_{-i} $(i = 1, 2)$, the firms' decisions become

$$\begin{aligned} \theta_i &= \frac{1}{2}\left(1 + \frac{c(g_i - g_{-i})}{k_m}\right), \\ k_m &= \frac{1}{3}\left(2 + c(g_i + g_{-i}) - 2t^c\right), \\ k_{ni} &= \frac{1}{2}(1 + g_i - t^c). \end{aligned}$$

For a given common tax rate t^c, jurisdiction $i = 1, 2$ chooses the level g_i of infrastructure that maximizes its objective function

$$B_i = (M\theta_i k_m + k_{ni})\, t^c - \gamma \frac{g_i^2}{2}$$

The first order conditions yield

$$g^c = \frac{3 + 4Mc}{6\gamma} t^c.$$

Accordingly, we have

$$\begin{aligned} \theta^c &= \frac{1}{2}, \\ k_m^c &= \frac{2}{3}\left(1 + cg^c - t^c\right), \\ k_n^c &= \frac{1}{2}(1 + g^c - t^c). \end{aligned}$$

The common tax rate t^c is set cooperatively to maximize the joint net revenue $B_i + B_{-i} = F(t)$. After taking account of the above results, joint tax revenue becomes

$$F(t) = \frac{-4\gamma\,(2M + 3) + 4Mc + 3}{12\gamma}\,(t^c)^2 + \frac{1}{3}\,(2M + 3)\,t^c$$

Note that the strict concavity of $F(t)$ requires that $\gamma > \frac{4Mc+3}{4(2M+3)}$.

We thus get the harmonized tax rate

$$t^c = \frac{2\gamma\,(2M + 3)}{4\gamma\,(2M + 3) - (4Mc + 3)}.$$

The equilibrium infrastructure provision in each country i becomes

$$g^c = \frac{(3+4Mc)}{6\gamma} t^c.$$

The positiveness of g^c and t^c and the condition $t^c < 1$ require that $\gamma > \underline{\gamma} = \frac{4Mc+3}{2(2M+3)}$.

The equilibrium net tax revenue of country i equals

$$B^c = \frac{\frac{1}{6}\gamma (2M+3)^2}{4\gamma (2M+3) - (4Mc+3)}.$$

It appears that $B^c > 0$ because $\gamma > \underline{\gamma}$.

Finally, note that for each country, net tax revenue is higher under tax harmonization than under tax competition. Indeed, it can be easily demonstrated that $B^c > B^*$.

Now, we analyze the impact of an increase in mobile capital M on the harmonized tax rate and the equilibrium infrastructure expenditures. We see that

$$\begin{aligned} \frac{\partial t^c}{\partial M} &= 12\gamma \frac{2c-1}{(2\gamma (4M+1) - (4Mc+3))^2}, \\ \frac{\partial g^c}{\partial M} &= \frac{2c}{3\gamma} t^c + \frac{2(3+4Mc)(2c-1)}{(3(4\gamma-1) + 4M(2\gamma - c))^2}. \end{aligned}$$

It follows that the common tax rate and the equilibrium infrastructure provision increase with mobile capital when MNC affiliates benefit sufficiently from public infrastructure. Formally, when $c > \frac{1}{2}$, we have $\frac{\partial t^c}{\partial M} > 0$ and $\frac{\partial g^c}{\partial M} > 0$.

However, when $c < \frac{1}{2}$, the tax rate decreases with M. The impact of an increase in mobile capital supply on infrastructure provision crucially depends on the value of γ. We can easily check that $\frac{\partial g^c}{\partial M} > 0$ when[11] $\gamma > \widetilde{\gamma}_g = \frac{(4Mc+3)^2}{8c(2M+3)^2}$ and $\frac{\partial g^c}{\partial M} < 0$ when $\underline{\gamma} < \gamma < \widetilde{\gamma}_g$.

Similar to what we showed in Figure 1, there are three regions according to different values of γ and c.

Region 1 When $0 < c < \frac{3}{4M+12}$ and $\underline{\gamma} < \gamma < \widetilde{\gamma}_g$, then $\frac{\partial t^c}{\partial M} < 0$ and $\frac{\partial g^c}{\partial M} < 0$.

[11] When $c < \frac{1}{2}$ we have $\underline{\gamma} < \widetilde{\gamma}$.

Region 2 When $\frac{1}{2} > c > \frac{3}{4M+12}$, then $\frac{\partial t^c}{\partial M} < 0$ and $\frac{\partial g^c}{\partial M} > 0$.

Region 3 When $c > \frac{1}{2}$, then $\frac{\partial t^c}{\partial M} > 0$ and $\frac{\partial g^c}{\partial M} > 0$.

We now analyze the impact of an increase in mobile capital M on investment and profitability of local firms. To this end, we calculate sign of the following derivative

$$\frac{\partial k_n^c}{\partial M} = \frac{4c\left(24M + 8M^2 + 9\right) + 18\gamma - \left(4Mc + 3\right)^2}{3\left(12\gamma + 8M\gamma - 4Mc - 3\right)^2}. \tag{12}$$

It is easy to see that $\frac{\partial k_n^c}{\partial M} > 0$ when $\gamma > \widetilde{\gamma}_k = \frac{(4Mc+3)^2}{4c(24M+8M^2+9)+18}$. Note that $\widetilde{\gamma}_k < \underline{\gamma}$ for $c > \frac{1}{2}$. Consequently, $\frac{\partial k_n^c}{\partial M} > 0$ when $c > \frac{1}{2}$. When $\underline{\gamma} < \gamma < \widetilde{\gamma}_k$, which only can occurs when $c < \frac{1}{2}$, we have $\frac{\partial k_n^c}{\partial M} < 0$. Moreover, when $c < \frac{1}{2}$, we can show that $\widetilde{\gamma}_g > \widetilde{\gamma}_k > \underline{\gamma}$.

Therefore, investment and profits of local firms can decrease as a result of an increase in mobile capital. For this to happen, a necessary condition is that $\frac{\partial t^c}{\partial M} < 0$ and $\frac{\partial g^c}{\partial M} < 0$. The adverse effect of M on local firms occurs when public infrastructure provision decreases to such an extent that it cannot be compensated by a tax decrease.

Proposition 3 *Infrastructure competition with harmonized tax rates does not prevent an increase in mobile capital possibly harming the profitability of local firms.*

3.1 Local firms' profits: tax and infrastructure competition vs tax harmonization

First, we compare the harmonized tax rate t^c with the equilibrium rate t^* resulting from tax competition. It is easy to check that $t^c > t^*$ for $\gamma > \gamma_\Delta = \frac{c(4Mc+3)}{6}$ and $t^* > t^c$ otherwise. In other words, tax harmonization can result in a relative lower rate even if it is preferred to tax competition ($B^c > B^*$).

To understand the underlying intuition, note that $t^c > t^*$ when the host-countries are not very efficient in infrastructure provision ($\gamma > \gamma_\Delta$). As a result, jurisdictions focus on tax policy to attract mobile capital and, consequently, set low tax rates in equilibrium. It follows that tax harmonization increases the taxation level. When the host countries are very efficient in providing infrastructure, their focus shifts to infrastructure competition, which reduces pressure on tax rates. In this case, harmonization leads to lower taxation.

Now, we verify under what conditions the local firms' profitability increases with tax harmonization,

$$\Pi_n^c > \Pi_n^* \Longrightarrow \left[\frac{1}{2}(1+g^c-t^c)\right]^2 > \left[\frac{1}{2}(1+g^*-t^*)\right]^2.$$

Given that $g^* = \frac{3+4cM}{6\gamma}t^*$ and $g^c = \frac{3+4cM}{6\gamma}t^c$, the above condition becomes

$$\Pi_n^c > \Pi_n^* \Longrightarrow \Gamma \cdot \Delta > 0$$

with $\Gamma = \frac{3+4cM}{6\gamma} - 1$ and $\Delta = t^c - t^*$

It follows that $\Pi_n^c > \Pi_n^*$ if Γ and Δ are positively signed.[12] This happens when $\gamma > \max(\underline{\gamma}, \gamma_\Delta)$ with $\gamma_\Delta = \frac{c(4Mc+3)}{6}$ and $\gamma < \gamma_\Gamma = \frac{4Mc+3}{6}$, or when $\gamma \in (\max\{\underline{\gamma}, c\gamma_\Gamma\}, \gamma_\Gamma)$. Conversely, we have $\Pi_n^* > \Pi_n^c$ if $\underline{\gamma} < \gamma < c\gamma_\Gamma$ when $1 > c > \frac{3}{2M+3}$ or if $\gamma > \gamma_\Gamma$.

Before explaining the underlying intuition of the above results, we first note that relative to tax competition, tax harmonization moves tax and infrastructure provision in the same direction. For example, if the tax rate increases as a result of tax harmonization, infrastructure provision will increase too. If the latter effect dominates the former one, the profitability of local firms will increase. This is exactly what happens when $\gamma \in (\max\{\underline{\gamma}, c\gamma_\Gamma\}, \gamma_\Gamma)$. However, if tax harmonization raises tax so far that they cannot be compensated by more infrastructure provision, then local firms lose profit relative to tax competition. This happens when $\gamma > \gamma_\Gamma$. Finally, depending on the value of parameters γ and c, the harmonized tax rate may be lower than that under tax competition. In this case, we are left with only one case.[13] The profits of local firms decline because lower infrastructure provision is not compensated by the tax decrease.

Proposition 4 *Infrastructure competition with tax harmonization lowers the profitability of local firms relative to tax and infrastructure competition if the increase of the harmonized tax rate is not compensated by higher infrastructure provision.*

[12] Note that we also have $\Pi_{ni}^c > \Pi_{ni}^*$ when Γ and Δ are both negatively signed. This case can be ruled out because $c \in [0, 1]$.

[13] The reason is that c is bounded from above by 1.

4 Tax discrimination

In this section, we consider different tax rates on mobile and immobile capital. Owners of immobile capital can only respond to tax changes by changing the level of their local investment, but owners of mobile capital can react by changing the amount they invest or the location of their investment. The tax rate on international capital in country i is denoted by t_i and the tax rate on immobile capital by τ_i. It follows that now the jurisdictions compete in both t_i and g_i for international mobile capital. Each country i sets the variables t_i, τ_i and g_i to maximize the following objective function

$$B_i = M\theta_i k_m t_i + k_{ni}\tau_i - \gamma\frac{g_i^2}{2}.$$

The first order conditions that are also sufficient yield the following results after assuming by symmetry that $t_i = t_{-i}, \tau_i = \tau_{-i}, g_i = g_{-i}$,

$$\begin{aligned} t_i &= \frac{1}{3}cg_i + \frac{1}{3}, \\ \tau_i &= \frac{1}{2}g_i + \frac{1}{2}, \\ g_i &= \frac{1}{6\gamma}\left(3\tau_i + 4Mct_i\right). \end{aligned}$$

It follows that in each country i, equilibrium infrastructure provision and tax rates on mobile and immobile firms are respectively

$$\begin{aligned} \overline{g} &= \frac{8Mc+9}{36\gamma - 8Mc^2 - 9}, \\ \overline{t} &= \frac{1}{3}\left(c\overline{g}+1\right) = \frac{3\left(c+4\gamma-1\right)}{36\gamma - 8Mc^2 - 9}, \\ \overline{\tau} &= \frac{1}{2}\left(\overline{g}+1\right) = \frac{2\left(-2Mc^2+2Mc+9\gamma\right)}{36\gamma - 8Mc^2 - 9}. \end{aligned}$$

We impose that $\gamma > \gamma_\tau = \frac{2}{9}Mc^2 + \frac{2}{9}Mc + \frac{1}{2}$ to guarantee that $\overline{g} > 0$, $1 > \overline{\tau} > 0$ and $1 > \overline{t} > 0$.

It is easy to see that $\overline{\tau} > \overline{t}$ if $\gamma > \frac{1}{6}\left(c-1\right)\left(4Mc+3\right),$ which always holds for $c \in [0,1]$ and $\gamma > 0$. In other words, immobile capital is taxed more than mobile capital.

Given that $\overline{k}_n = \frac{1}{2}(1 + \overline{g} - \overline{\tau})$ and $\overline{\Pi}_n = \left(\overline{k}_n\right)^2$, in equilibrium investment and profit of local firms are respectively

$$\begin{aligned} \overline{k}_n &= \frac{2Mc - 2Mc^2 + 9\gamma}{36\gamma - 8Mc^2 - 9}, \\ \overline{\Pi}_n &= \left(\frac{2Mc - 2Mc^2 + 9\gamma}{36\gamma - 8Mc^2 - 9}\right)^2. \end{aligned}$$

It is easy to see that $\overline{k}_n > 0$ if $\gamma > \gamma_\tau$.

In the following, we analyze how an increase in mobile capital affects equilibrium variables. From above we know that $\gamma_\tau > \frac{1}{4}(1 - c)$ and hence $\frac{\partial\, \overline{g}}{\partial M} > 0$, $\frac{\partial \overline{t}}{\partial M} > 0$, and $\frac{\partial\, \overline{\tau}}{\partial M} > 0$. In particular, the tax rate on mobile (and immobile) capital increases in M.

Moreover, we see that an increase in mobile capital M increases local firms' investment and profit ($\frac{\partial \overline{k}_n}{\partial M} > 0$) because the elasticity of infrastructure provision to mobile capital is higher than that of local tax rates.[14]

Proposition 5 *Under tax discrimination an increase in mobile capital relative to immobile capital is beneficial to local firms.*

4.1 Local firms' profits with and without tax discrimination

Now, we analyze the impact of tax and infrastructure competition on the profit of local firms when we consider no tax discrimination and tax discrimination. In other words, we compare Π^*_{ni} with $\overline{\Pi}_{ni}$. We can write

$$\Pi^*_n - \overline{\Pi}_n = (k^*_n)^2 - \left(\overline{k}_n\right)^2.$$

It follows that the sign of $\Pi^*_n - \overline{\Pi}_n$ and $\Phi = k^*_n - \overline{k}_n$ are the same. After calculations, we obtain

$$\Phi = \frac{\tilde{\Delta}}{D\,(36\gamma - 8Mc^2 - 9)},$$

where

$$\begin{aligned} \tilde{\Delta} =& 108M\gamma^2 + (-6Mc\,(16Mc - 12M + 3))\,\gamma + \\ &+ M\,(c-1)\left(16M^2c^3 - 12Mc^2 + 36Mc - 18c + 27\right). \end{aligned}$$

[14] $\epsilon_g = \frac{dg}{dM}\frac{M}{g} > \epsilon_\tau = \frac{d\tau}{dM}\frac{M}{\tau} = \frac{dg}{dM}\frac{M}{g+1}$.

Knowing that $\frac{1}{D(36\gamma-8Mc^2-9)} > 0$, we have to check the sign of the numerator $\tilde{\Delta}$.

The two real roots of $\Delta = 0$ for γ are $\gamma_1 = -\frac{1}{3}c + \frac{2}{9}Mc^2 + \frac{1}{2} > 0$ and $\gamma_2 = \frac{1}{2}c + \frac{2}{3}Mc^2 - \frac{2}{3}Mc - \frac{1}{2} < 0$, respectively. We know from above that $\gamma > \gamma_\tau$ and $\gamma > \widehat{\gamma}$. Since $\gamma_\tau - \widehat{\gamma} > 0$ we have to assume that $\gamma > \gamma_\tau = \frac{2}{9}Mc^2 + \frac{2}{9}Mc + \frac{1}{2}$.

It is easy to verify that $\gamma_\tau > \gamma_1$ and consequently, $\tilde{\Delta} > 0$ for $\gamma > \gamma_\tau$. It follows that $k^*_{ni} > \overline{k}_{ni}$ and $\Pi^*_{ni} > \overline{\Pi}_{ni}$ for $\gamma > \gamma_\tau$. The profit of local firms with no tax discrimination is higher than that under tax discrimination. To understand why this occurs, note that under tax discrimination, local firms pay higher taxes than without tax discrimination. This contributes to a decrease in local profits that is not compensated by a change in the infrastructure provision.[15]

Proposition 6 *Tax discrimination decreases the profitability of local firms.*

5 Conclusions

The literature on tax competition generally focuses on mobile firms, neglecting the possible impact on immobile firms. Immobile capital is only considered when tax discrimination is analyzed. However, as official data indicate, an important share of global GDP results from local firms with immobile capital. Even if local firms are not targeted by policies aimed at attracting foreign mobile capital, they are nonetheless affected by these decisions. The aim of our paper is to account for this effect by developing a theoretical model. The main conclusion is that tax and infrastructure competition for mobile capital can harm local investment and the profitability of local firms if mobile firms only weakly benefit from local infrastructure provision. This result also holds if countries harmonize corporate taxation but still compete with infrastructure provision to attract foreign capital. Moreover, we show that tax harmonization is not always beneficial to local businesses.

It follows that the quality of infrastructure provision determines the impact on local firms from competition to attract foreign capital. To prevent adverse effects on the profitability of local businesses, policymakers should give sufficient weight to internationally mobile firms when designing infrastructure provision. These effects could be further explored in a possible

[15] Indeed, it is easy to prove that $t^* - \overline{\tau} < 0$ given the above condition $\gamma > \widehat{\gamma}$.

extension of the present paper that endogenizes the type of infrastructure provision under the constraint that tax and infrastructure competition should not be harmful to local firms.

Finally, when countries use tax discrimination to attract mobile capital, a relative increase in mobile capital always increases local firms' capital investment and profit. This provides further evidence that tax discrimination is harmful, as already observed by many authors.

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